

CONNECTICUT RIVER FLOOD CONTROL

CONANT BROOK DAM

CONANT BROOK, MASSACHUSETTS

CHICOPEE FALLS

LOCAL PROTECTION PROJECT

CHICOPEE RIVER, MASSACHUSETTS

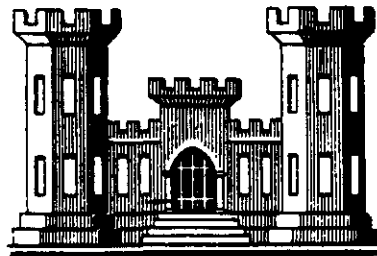
WESTFIELD

LOCAL PROTECTION PROJECT

WESTFIELD RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO.4

CONCRETE AGGREGATES



**U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.**

NOVEMBER 1962

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS

424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.
NEDGW

9 November 1962

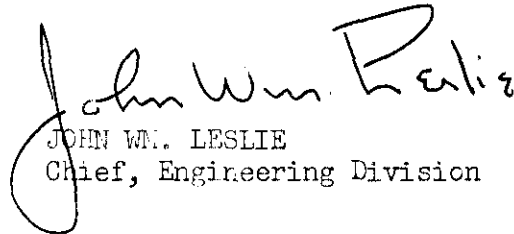
SUBJECT: Conant Brook Dam, Chicopee Falls Local Protection
Project, Westfield Local Protection Project, Massachusetts
Design Memorandum No. 4 - Concrete Materials

TO: Chief of Engineers
ATTENTION: ENGCW-E
Department of the Army
Washington 25, D.C.

There is submitted for review and approval Design
Memorandum No. 4 - Concrete Materials for the Conant Brook
Dam and the Chicopee Falls Local Protection Project, Chicopee
River Basin, Massachusetts, and the Westfield Local Protection
Project, Westfield River, Massachusetts, in accordance with
EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

Incl (10 cys)
Design Memo No. 4


JOHN WM. LESLIE
Chief, Engineering Division

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
OFFICE OF DIVISION ENGINEER
WALTHAM 54, MASSACHUSETTS

FLOOD CONTROL PROJECTS

CONANT BROOK DAM AND RESERVOIR - CONANT BROOK
CHICOPEE FALLS LOCAL PROTECTION PROJECT - CHICOPEE RIVER
WESTFIELD LOCAL PROTECTION PROJECT - WESTFIELD RIVER

CONNECTICUT RIVER BASIN - MASSACHUSETTS

DESIGN MEMORANDUM NO. 4
CONCRETE MATERIALS

NOVEMBER 1962

1. General. Construction of the subject projects which are located in the same river basin, approximately seventeen (17) miles apart, will be concurrent. The approximate quantities of concrete required for construction of walls, intake and outlet works and spillway for the dam project and flood walls for the local protection projects are as follows:

- a. Conant Brook Dam, 3,000 cubic yards.
- b. Chicopee Falls Local Protection, 8,000 cubic yards.
- c. Westfield Local Protection, 5,000 cubic yards.

In view of the small quantities involved, it is not considered economically feasible to process aggregates on any of the sites; and, therefore, aggregate investigations have been confined to established commercial sources. There are six (6) commercial sources within a 25-mile haul distance. Two commercial sources each within a four-mile haul distance of a project site have been recently investigated and tested. Four (4) additional commercial sources were previously tested and approved for civil works construction. Location of projects and sources of aggregate are shown on Plate 4-1.

2. Investigations. Selection of sources for testing was based on plant facilities and characteristics of materials as determined by visual examination and local usage. All of the commercial sources investigated are developed in traprock or glacial deposits of sand and gravel.

3. Tests. Results of aggregate tests are summarized in Table Nos. 4-1 and 4-2.

4. Relative Cost Estimates. Estimated delivered prices of aggregates, based on quoted plant prices and Massachusetts Department of Public Utilities minimum trucking rates, which are currently twenty-five cents per ton for the first mile and five cents per ton for each additional mile, and plant locations are as follows:

a. Monson Sand & Gravel Company. The processing plant is located in Monson, Massachusetts about a two (2) mile haul distance to the Conant Brook Damsite. Quoted plant prices are \$1.50 per ton to \$2.25 per ton for gravel, depending on size group, and \$0.90 per ton for concrete sand. The delivered price to the Conant Brook Damsite will average \$2.15 per ton for gravel and \$1.20 per ton for sand.

b. North Wilbraham Sand & Gravel, Incorporated. The processing plant and transit-mix plant are located in North Wilbraham, Massachusetts. Quoted plant prices are \$1.90 per ton to \$2.40 per ton for gravel, depending on size group and \$1.20 per ton for concrete sand. The approximate haul mileages and estimated average prices for gravel and concrete sand to the various sites are shown in the following table:

<u>Site</u>	<u>Haul Mileage</u>	<u>Price per Ton</u>	
		<u>Gravel</u>	<u>Sand</u>
Chicopee Falls	5	\$ 2.60	\$ 1.65
Conant Brook	10	2.85	1.90

c. A. Giard & Sons, Incorporated. The processing plant and transit-mix plant are located in Ware, Massachusetts, about twelve (12) miles haul distance to the Conant Brook Damsite. Quoted plant prices are \$1.35 per ton for gravel and \$0.80 per ton for concrete sand. The delivered price to the Conant Brook Damsite will be \$2.15 per ton for gravel and \$1.60 per ton for sand.

d. John S. Lane & Sons, Incorporated. The sand and gravel processing plant is located in Westfield, Massachusetts. Quoted plant prices are \$1.70 per ton to \$2.15 per ton for gravel, depending on size group and \$1.10 per ton for concrete sand. The approximate haul mileages and estimated average prices for gravel and concrete sand to the various sites are shown in the following table:

<u>Site</u>	<u>Haul Mileage</u>	<u>Price per Ton</u>	
		<u>Gravel</u>	<u>Sand</u>
Westfield	4	\$ 2.30	\$ 1.50
Chicopee Falls	14	2.80	2.00

e. John S. Lane & Sons, Incorporated. The crushed stone processing plant is located in Westfield, Massachusetts. Quoted plant prices are \$1.40 per ton to \$2.75 per ton for crushed stone, depending on size group. The approximate haul mileage and estimated average price for crushed stone to the various sites are shown in the following table:

<u>Site</u>	<u>Haul Mileage</u>	<u>Price per Ton</u>
		<u>Crushed Stone</u>
Westfield	1	\$ 2.05
Chicopee Falls	11	2.55

f. Bill Willard, Incorporated. The processing plant and transit-mix plant are located in Northampton, Massachusetts. Quoted plant

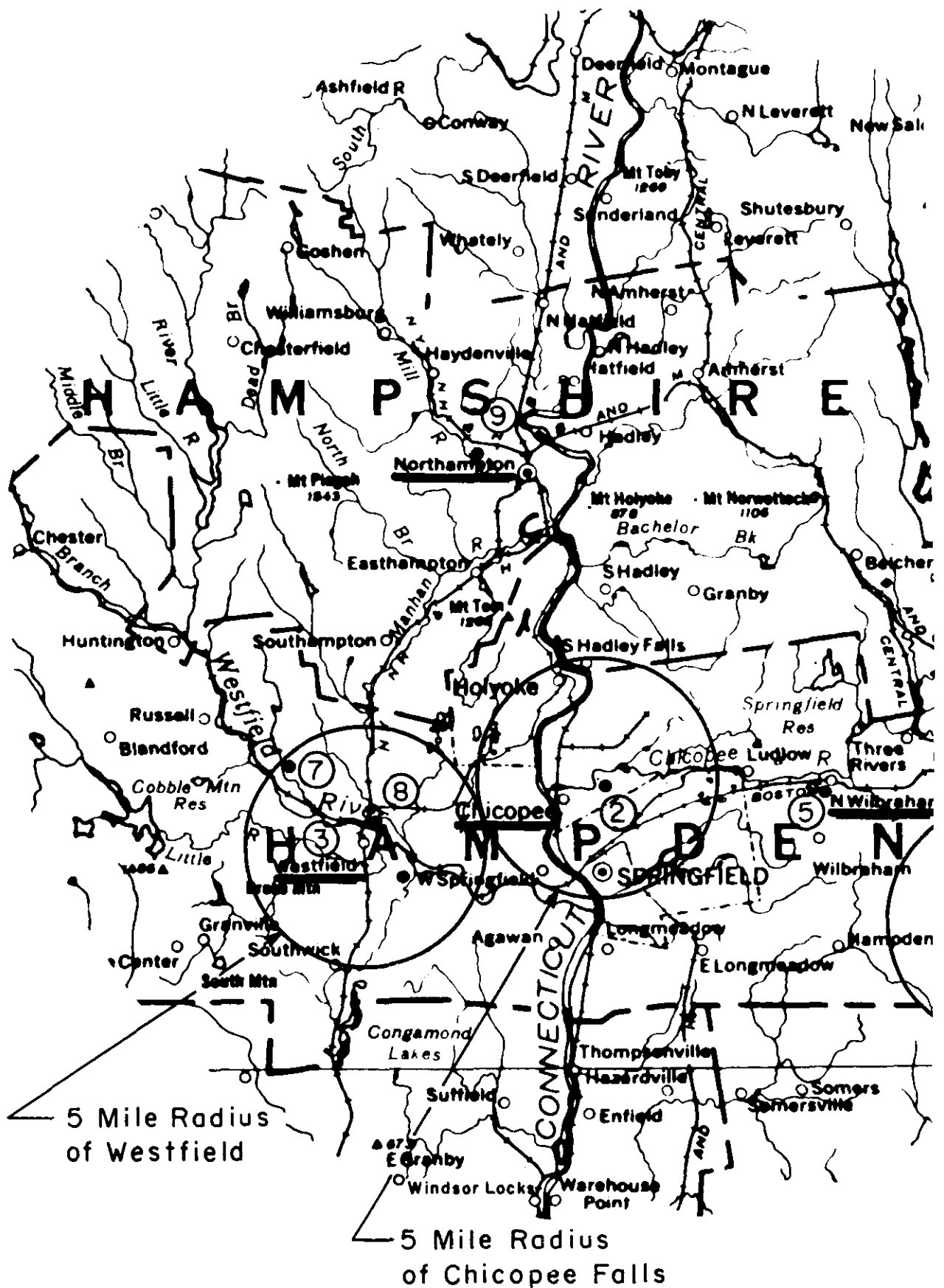
prices are \$1.55 per ton for gravel and \$0.50 per ton for concrete sand. The approximate haul mileage and estimated average price for gravel and sand at the various sites are shown in the following table:

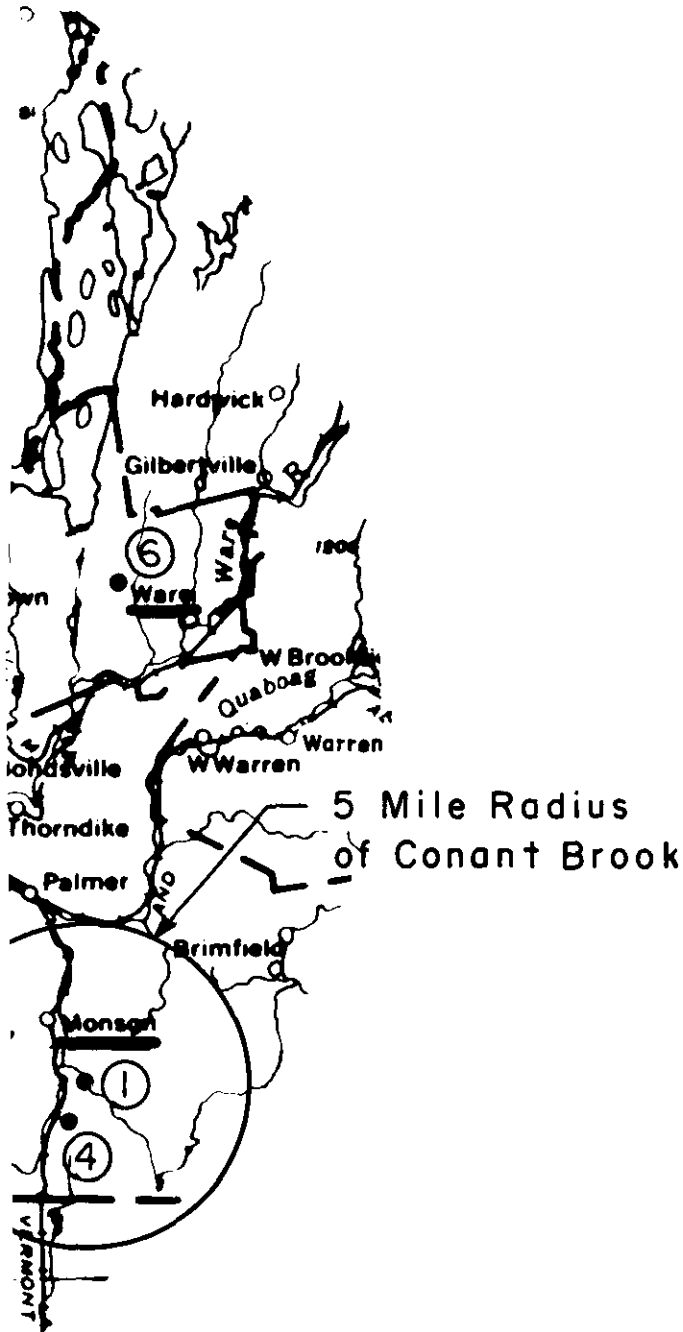
<u>Site</u>	<u>Haul Mileage</u>	<u>Price per Ton</u>	
		<u>Gravel</u>	<u>Sand</u>
Chicopee Falls	14	\$ 2.45	\$ 1.40
Westfield	21	2.80	1.75

5. Service Records for Aggregates. The concrete aggregates from the above listed sources have been used in a number of Federal, State and local projects except John S. Lane & Sons, Incorporated sand and gravel which is a recently developed source. The quarry stone coarse aggregate from John S. Lane & Sons, Incorporated has been used for more than twenty years in Corps of Engineers civil works and military projects and its service record is excellent. The performance of aggregates from sources other than John S. Lane & Sons, Incorporated is satisfactory; although it must be noted that these materials have not been used extensively in important structures and the period of record is less than ten years. The fine and coarse aggregates from Monson Sand & Gravel Company, although used in state and local building construction, are not approved for Commonwealth of Massachusetts Department of Public Works highway construction, because of non-conformance to resistance to abrasion requirements.

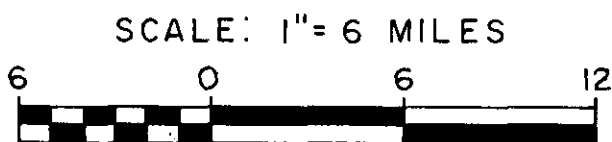
6. Recommendations and Conclusions. Based on the data presented herein, it is considered that all sources are acceptable except Monson Sand & Gravel Company. The aggregate test results and comparative costs indicate for the Conant Brook Dam and Reservoir project that aggregates from the North Wilbraham Sand & Gravel Company and A. Giard & Sons,

Incorporated are superior in quality and economically competitive with Monson Sand & Gravel Company. It is recommended all sources as listed be approved except Monson Sand & Gravel Company





- ① Conant Brook Dam and Reservoir
- ② Chicopee Falls Local Protection
- ③ Westfield Local Protection
- ④ Monson Sand and Gravel Co.
- ⑤ No. Wilbraham Sand and Gravel Co.
- ⑥ A. Giard and Sons, Inc.
- ⑦ J. S. Lane and Sons, Inc. (gravel)
- ⑧ J. S. Lane and Sons, Inc. (quarry)
- ⑨ Bill Willard, Inc.



CONNECTICUT RIVER FLOOD CONTROL

CONANT BROOK CHICOPEE FALLS WESTFIELD

CONANT BROOK
CHICOPEE RIVER
WESTFIELD RIVER

MASSACHUSETTS
MASSACHUSETTS
MASSACHUSETTS

ANALYSIS OF AGGREGATE - U.S. STANDARD SIEVE PERCENT PASSING - BY WEIGHT										FINENESS MODULUS	LA ABRASION TEST 500 REVOLUTIONS PERCENT LOSS	SOUNDNESS TEST 5 CYCLES - MgSO ₄ PERCENT LOSS	ORGANIC IMPURITIES (PPM) ASTM PLATE I	MORTAR STRENGTH PERCENT OF STANDARD			PARTICLES FLAT AND ELONGATED PERCENT BY WEIGHT	ALKALI REACTIVITY	DELETERIOUS MATERIALS	ABSORPTION PERCENT	SPECIFIC GRAVITY			COMPRESSIVE STRENGTH, PSI									LINEAL COEFFICIENT THERMAL EXPANSION X 10 - 6 / °F	DURABILITY FACTOR (DFE) 300 CYCLES	
INCHES														3 DAY	7 DAY	28 DAY					7 DAY AVERAGE			14 DAY AVERAGE			28 DAY AVERAGE								
U.S. STANDARD SIEVES NUMBERS																					CEMENT FACTOR			CEMENT FACTOR			CEMENT FACTOR								
3/4	1/2	3/8	4	8	16	30	50	100	200												5.0	6.0	7.0	5.0	6.0	7.0	5.0	6.0	7.0						
30	24 96 100	3 35 99	- 9 87	- - 17	- - 9	- - -	- - -	- - -	0.4 0.8 1.1	7.76 6.25 5.88	52	10 10 -	-	-	-	-	3 3 4	Innoc	None	0.9 1.0 1.1	2.67 2.67 2.64	2.70 2.69 2.68	2.74 2.74 2.74	1830	2510	3170	2470	3300	3880	3360	4250	4320	5.2	50	
-	-	100	97	86	73	51	20	4	1.3	2.69	-	19	< 500	-	116	125	-	Innoc	None	0.6	2.69	2.71	2.74												
40	11 93 -	2 42 -	- 13 100	- 2 11	- 1 2	- - -	- - -	- - -	- - -	7.86 6.91 5.87	38	6	-	-	-	-	-	Innoc	None	1.2		2.69												4.4	77
-	-	100	99	88	68	15	21	6	-	2.73	-	10	< 500	-	-	-	-	Innoc	None	0.8		2.71												5.1	
60	16 90	2 28	- 7	- 2	- -	- -	- -	- -	- -	7.84 6.95	38	5	-	-	-	-	-	Innoc	None	2.2		2.58												4.7	78
-	-	100	99	88	43	15	4	-	-	2.82	-	14	< 500	-	-	-	-	Innoc	None	0.9		2.67												5.4	

Petrographic Analysis

Quartzite, 5% Schist, 9% Amphibolite and Hornblende Gneiss, 4% Basalt, 5% Diorite and 3% Miscellaneous with 20% highly weathered.
Types, 3% Feldspar, 2% Granite and 4% Miscellaneous with 11% weathered.
z and Quartzite, 9% Miscellaneous Rock Types, with 11% excessively weathered.
ecus Rock Types with 7% excessively weathered.
chist, 3% Quartz and Quartzite with 14% excessively weathered.
aneous Rock Types with 7% excessively weathered.

CONNECTICUT RIVER FLOOD CONTROL

CONANT BROOK

CHICOPEE FALLS

WESTFIELD

CONANT BROOK

CHICOPEE RIVER

WESTFIELD RIVER

MASSACHUSETTS

MASSACHUSETTS

MASSACHUSETTS

TABLE 4-1

ITEM NUMBER	SOURCE AND LOCATION	REMARKS AND SOURCE	HAUL IN MILES	MATERIAL TESTED (PROCESSED)	NOMINAL SIZE	TESTING LABORATORY AND DATE OF TESTS	SAMPLE NUMBER	SIEVE		
								SIEVE		
								2 1/2	2	1 1/2
1.	Monson Sand and Gravel Company Monson, Massachusetts	Operating Pit	2 CB	Crushed Gravel	1 1/2" 7/8" 1/2"	NED September 1962	71-16-1	-	-	100
							71-16-2	-	-	-
							71-16-3	-	-	-
2.				Processed Sand	No. 4		71-16-4	-	-	-
3.	North Wilbraham Sand and Gravel Company North Wilbraham, Massachusetts	Operating Pit	10 CB	Crushed Gravel	1 1/2" 1" 3/8"	SAD September 1956	82-440	-	-	100
			5 CF				82-399	-	-	-
							82-398	-	-	-
4.				Processed Sand	No. 4		82-397	-	-	-
5.	A. Giard and Sons, Inc. Ware Massachusetts	Operating Pit	12 CB	Crushed Gravel	1 1/2" 3/4"	SAD September 1956	82-403	-	-	110
							3-856-2	-	-	-
6.				Processed Sand	No. 4	NED October 1956	82-401	-	-	-

1. GRAVEL: The coarse aggregate is composed of about 47% Quartz-Biotite Gneiss, 16% Granite, 11% Quartz
2. SAND: The fine aggregate is composed of about 68% Quartz and Quartzite, 11% Gneiss, 12% Dark Basic
3. GRAVEL: The coarse aggregate is composed of about 68% Granite and Gneiss, 15% Hornblende Gneiss, 8% C
4. SAND: The fine aggregate is composed of about 49% Quartz, 29% Granite and Granite Gneiss, 22% Misc
5. GRAVEL: The coarse aggregate is composed of about 82% Granite and Gneiss, 8% Hornblende Gneiss, 7% M
6. SAND: The fine aggregate is composed of about 57% Quartz and Quartzite, 26% Granite Gneiss, 17% M

ANALYSIS OF AGGREGATE - U.S. STANDARD SIEVE PERCENT PASSING - BY WEIGHT											FINENESS MODULUS	LA ABRASION TEST 500 REVOLUTIONS PERCENT LOSS	SOUNDNESS TEST 5 CYCLES - MgSO ₄ PERCENT LOSS	ORGANIC IMPURITIES (PPM) ASTM PLATE I	MORTAR STRENGTH PERCENT OF STANDARD			PARTICLES FLAT AND ELONGATED PERCENT BY WEIGHT	ALKALI REACTIVITY	DELETERIOUS MATERIALS	ABSORPTION PERCENT	SPECIFIC GRAVITY			COMPRESSIVE STRENGTH, PSI									LINEAL COEFFICIENT THERMAL EXPANSION X 10 - 6/°F	DURABILITY FACTOR (DFE) 300 CYCLES
IN INCHES				U.S. STANDARD SIEVES NUMBERS											7 DAY AVERAGE							14 DAY AVERAGE			28 DAY AVERAGE										
															CEMENT FACTOR							CEMENT FACTOR			CEMENT FACTOR										
1	3/4	1/2	3/8	4	8	16	30	50	100	200					3 DAY	7 DAY	28 DAY					5.0	6.0	7.0	5.0	6.0	7.0	5.0	6.0	7.0					
30	31	9	7	-	-	-	-	-	-	1.0	7.42	8	-	-	-	-	1.2	2.66	2.68	2.72	1800	2330	2980	2430	3020	3630	3290	3880	4560	4.7	78				
00	97	49	28	10	-	-	-	-	-	1.0	6.49	11	-	-	-	-	1.2	2.63	2.66	2.73															
-	-	100	96	19	7	5	-	-	-	1.1	5.62	-	-	-	-	-	1.7	2.61	2.65	2.73															
-	-	-	100	99	88	75	48	24	9	2.5	2.57	-	8	<500	-	136	136	1.2	2.81	2.84	2.91														
37	7	1	-	-	-	-	-	-	-	-	7.96	13	1	-	-	-	0.5	-	2.96	-	2460	2910	3560	3390	3760	4290	4280	4680	5350	-	85				
00	97	59	30	1	-	-	-	-	-	-	6.72	-	1	-	-	-	0.8	-	2.95	-															
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-															
87	19	2	-	-	-	-	-	-	-	-	7.81	5	5	-	-	-	1.0	2.63	2.66	2.70	-	-	-	-	-	-	-	-	-	-	-				
00	98	12	4	3	-	-	-	-	-	-	6.95	44	3	-	-	-	1.3	2.62	2.65	2.71	-	-	-	-	-	-	-	-	-	-	-				
00	83	27	2	-	-	-	-	-	-	-	7.15	-	-	-	-	-	-	-	-	-	1790	2210	2840	2450	2940	3710	3430	3580	4410	5.9	49				
-	-	-	100	98	88	74	49	18	4	1	2.69	-	3	<500	-	130	158	0.9	2.67	2.69	2.73														

PETROGRAPHIC ANALYSIS

% Vein Quartz, 6% Basic Rock Types, 1% Miscellaneous with 8% Highly Weathered.
 Schist and Mica, 7% Garnet, 7% Feldspar, 4% Basic Rock Types, 3% Miscellaneous, with 12% Weathered.
 Containing up to 20% Clay and Clay-like materials.
 % Feldspar, 2% Basic Rock Type, and 2% Miscellaneous with 5% Highly weathered.
 Schist, 2% Basic Rock Types, 6% Miscellaneous with 28% Slightly weathered.

CONNECTICUT RIVER FLOOD CONTROL
 CONANT BROOK
 CHICOPEE FALLS
 WESTFIELD
 CONANT BROOK MASSACHUSETTS
 CHICOPEE RIVER MASSACHUSETTS
 WESTFIELD RIVER MASSACHUSETTS

TABLE 4-2

ITEM NUMBER	SOURCE AND LOCATION	REMARKS AND SOURCE	HAUL IN MILES	MATERIAL TESTED (PROCESSED)	NOMINAL SIZE	TESTING LABORATORY AND DATE OF TESTS	SAMPLE NUMBER	SIEV		
								SIEVE		
								2 1/2	2	1
7.	J. S. Lane and Sons, Inc. Westfield, Massachusetts	Operating Pit	W 4	Crushed Gravel	1 1/2" 3/4" 3/8"	NED September 1962	71-18-1	-	-	100
			CF 14				71-18-2	-	-	-
							71-18-3	-	-	-
8.				Processed Sand	No. 4		71-18-4	-	-	-
9.	J. S. Lane and Sons, Inc. Westfield, Massachusetts	Operating Quarry	W 1	Crushed Stone	1 1/2" 3/4"	WES July 1947		-	100	97
			CF 11					-	-	-
10.	Bill Willard, Inc. Northampton, Massachusetts	Operating Pit	CF 14	Crushed Gravel	1 1/2" 7/8" 5/8"	NED February 1961	71-5-1	-	-	100
			W 21				71-5-2	-	-	-
							71-5-3	-	-	-
11.				Processed Sand	No. 4		71-5-4	-	-	-

7. GRAVEL: The coarse aggregate is composed of about 37% Gneiss, 23% Quartzite, 13% Granite, 13% Schis
8. SAND: The fine aggregate is composed of about 52% Quartz and Quartzite, 14% Granite and Gneiss, 1
9. STONE: The coarse aggregate is composed of about 92% Dense, Fresh, Diabase and 8% Altered Diabase
10. GRAVEL: The coarse aggregate is composed of about 57% Granite, 15% Quartz and Quartzite, 16% Schis
11. SAND: The fine aggregate is composed of about 72% Quartz and Quartzite, 12% Feldspar, 3% Granite,